ASSAP Overview

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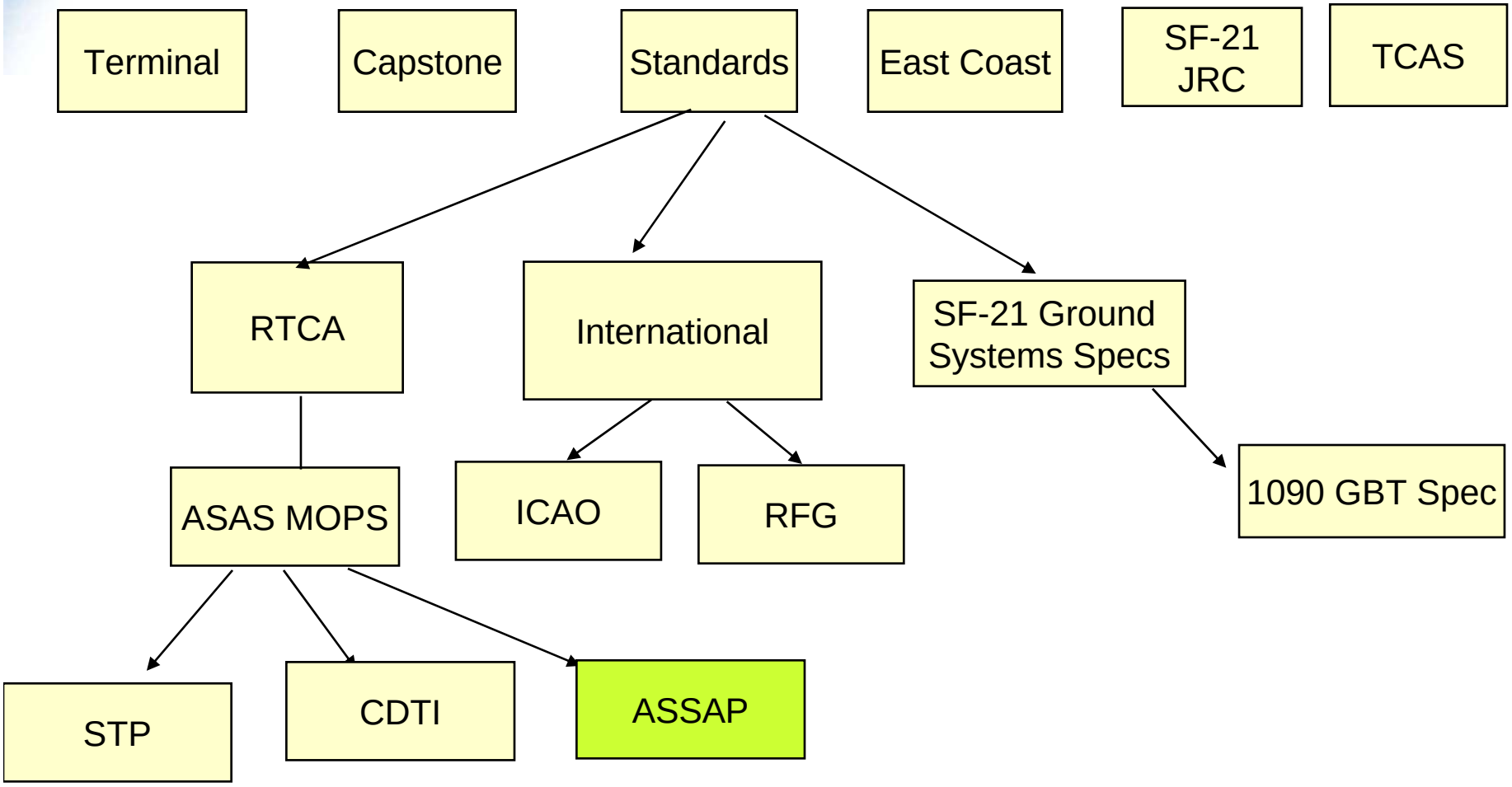
MITRE

Broadcast Services Activities FY'05



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Significance of ASSAP

- **ADS-B / TIS-B / TCAS Surveillance processing is fundamental to implementation of airborne applications**
- **Need common definitions and functional architecture specified for surveillance and applications**
- **Need common performance baseline and requirements for interoperability and minimum acceptability (certification / flight standards)**
- ***CAASD is the only organization that is putting a serious effort into this!***

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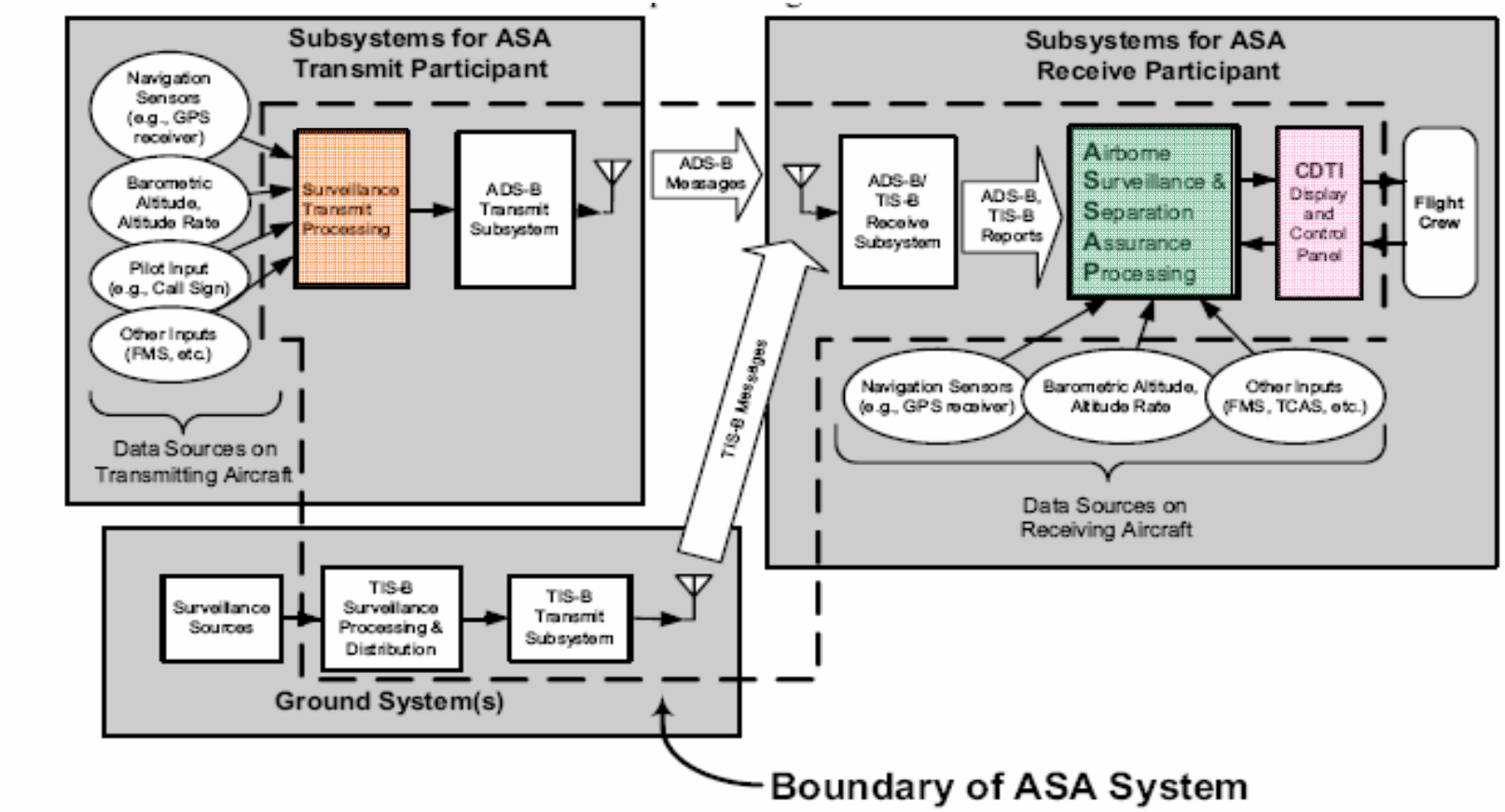
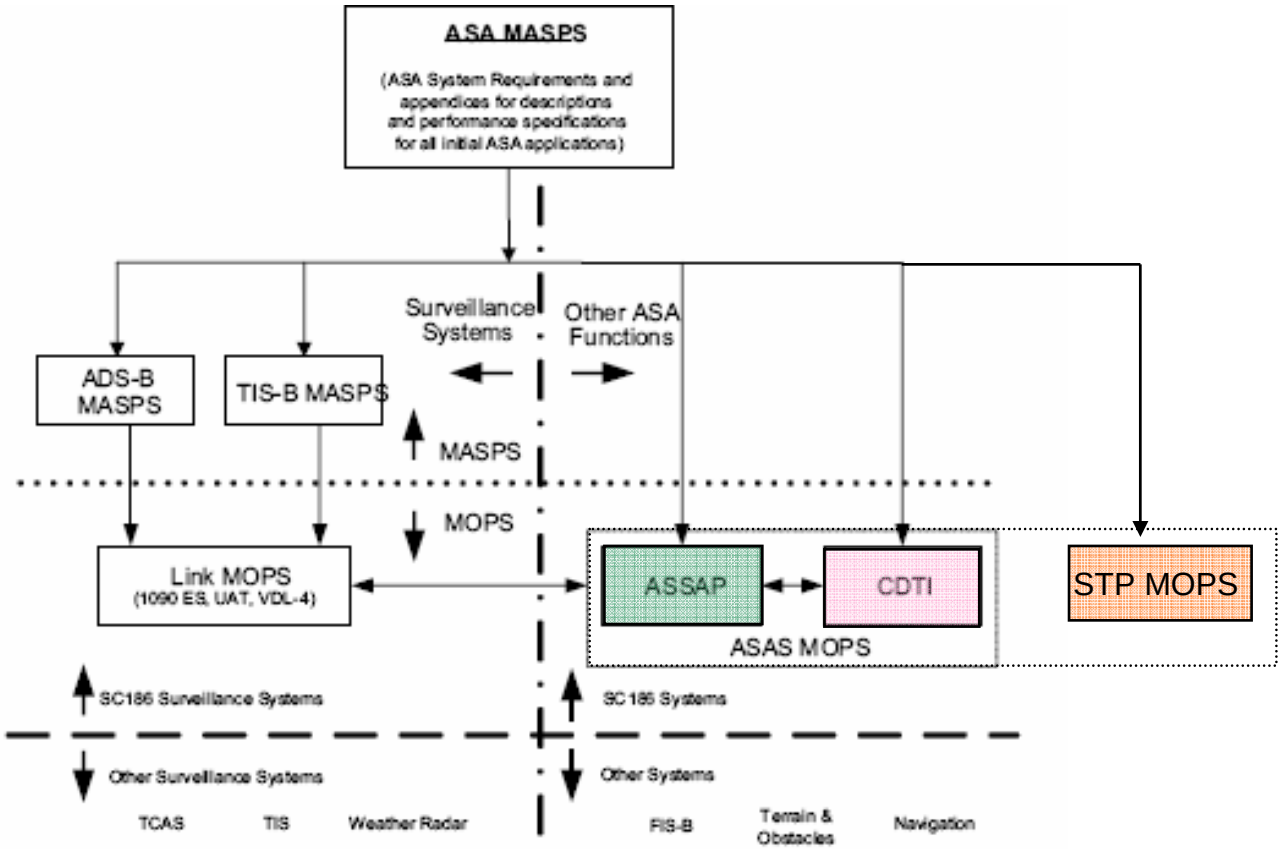
TASK Description

Our Task : Write the MOPS for the ASSAP Subsystem.



Relationship between ASSAP MOPS and other RTCA Documents



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High Level ASSAP Requirements

- **Surveillance Processing:**
  - **Establish Tracks from ADS-B and TIS-B traffic reports.**
  - **Correlate traffic from different surveillance sources (ADS-B, TIS-B, TCAS).**
  - **Select best source between ADS-B and TIS-B for application processing.**
  - **Indicate when a track is supported by TCAS (TCAS-tag to be used by CDTI).**
  - **Delete tracks that are beyond the maximum allowable coast time for any ASA application.**
- **Application Processing**
  - **Determine the appropriateness of track information for various applications (i.e., normal, degraded, not used).**
  - **Perform alerting functions (e.g., CD).**
  - **Maintain the interface to/from the CDTI Display and Control Panel subsystem.**

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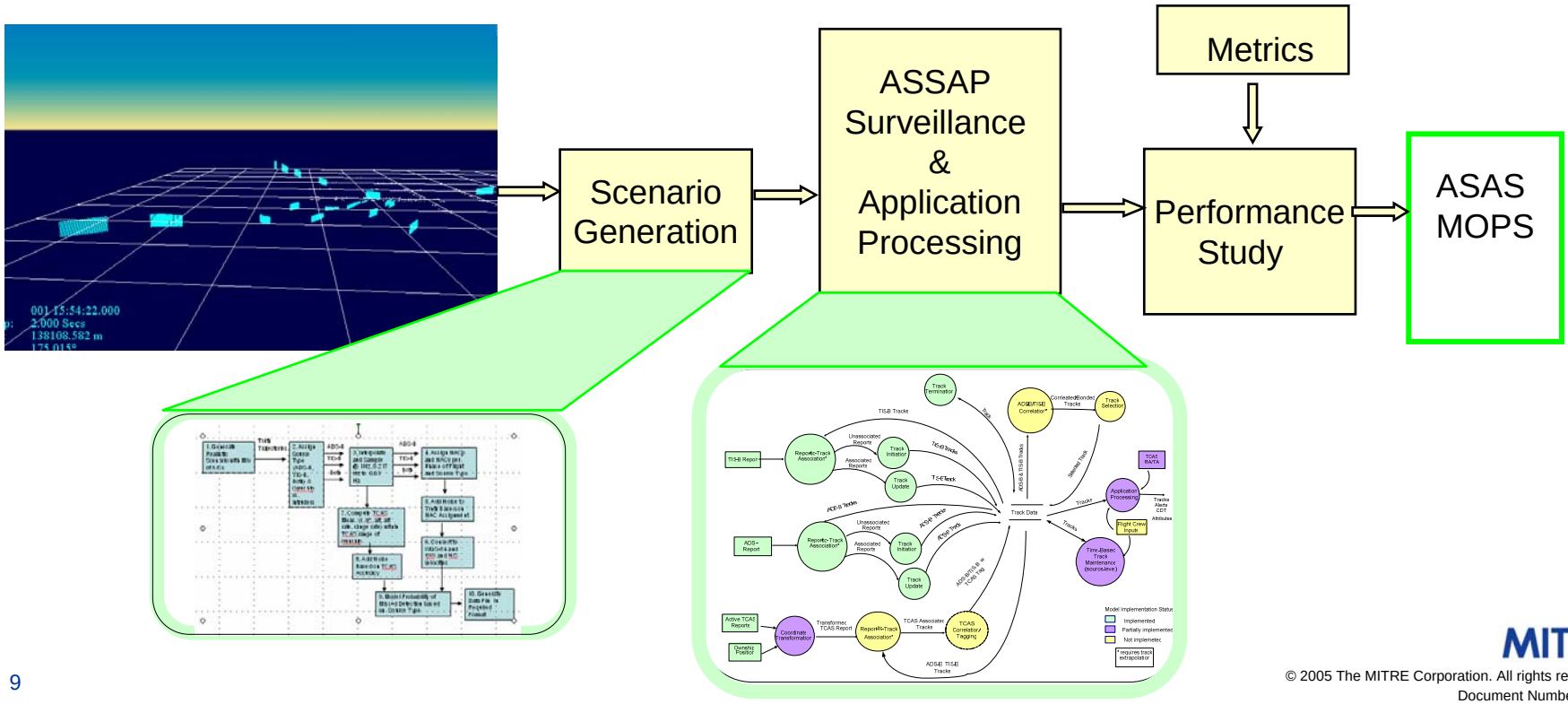
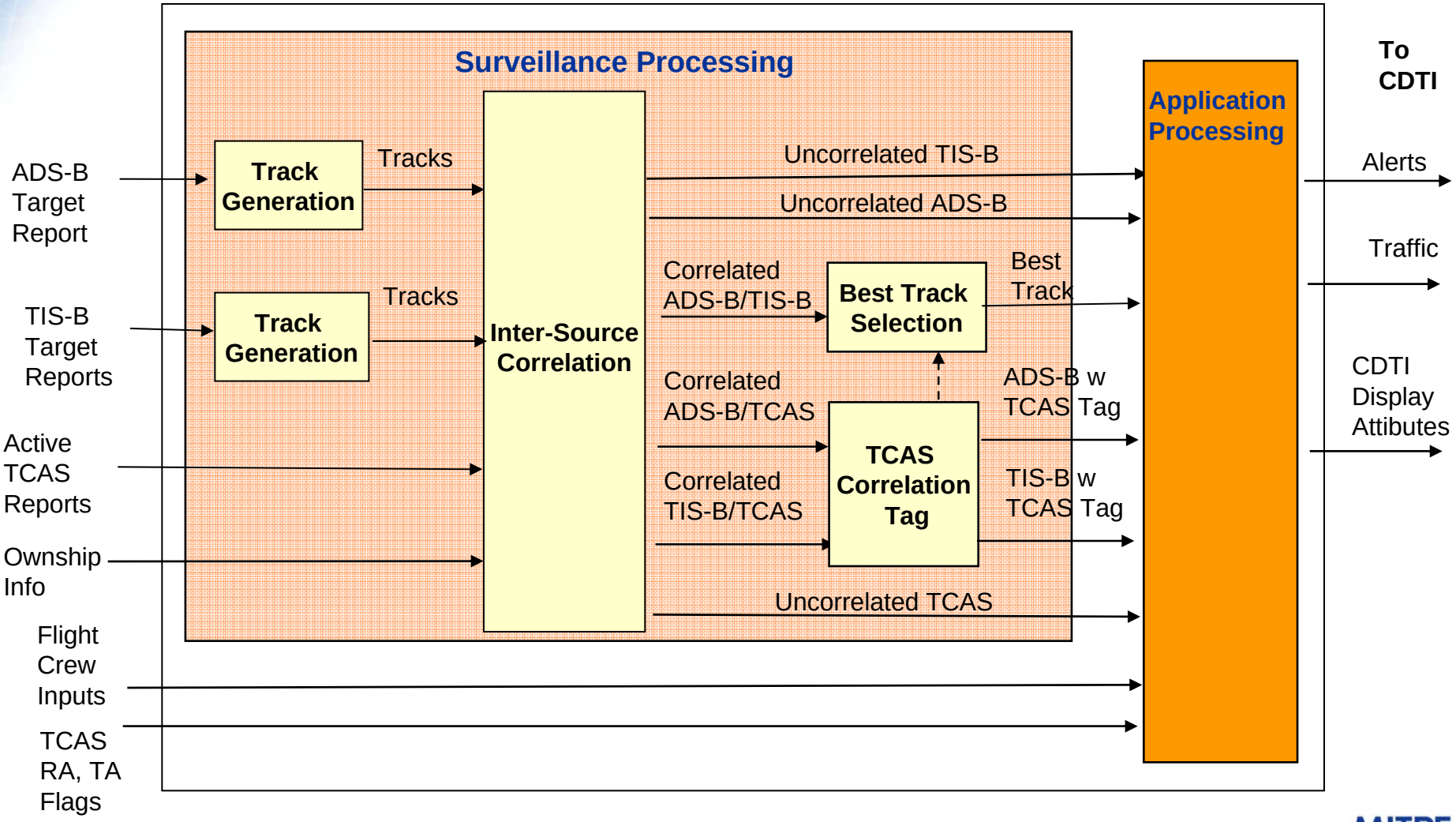
Approach to MOPS Specifications

- **Build simulation of ASSAP. Architectural approach:**
  - **Implement Distributed Tracking, Best-Of Track Selection, TCAS Tagging.**
- **Define and develop realistic scenarios.**
  - **Start with TASF scenarios as truth trajectories, simulate ADS-B, TIS-B, TCAS**
- **Use simulation results to develop MOPS level requirements.**
  - **Define metrics, Conduct Performance Study, Develop Requirements.**



Architectural Approach – Source-Level Tracking with Best Track Selection & TCAS Tagging



Highlights of Track Generation (Source-Level)

- **Motivation**
  - **ASSAP is required to *predict* track state and quality information contained in its *reports* from ADS-B and TIS-B sources at arbitrary times (i.e., between report times).**
- **Constraint**
  - **The ASSAP does not ingest measurements but tracked/filtered reports (i.e., consecutive reports are correlated).**
  - **Standard tracking techniques that expect measurements as input are not necessary.**
- **Filtering Method**
  - **A novel and simplified *degenerate Kalman Filter* that**
    - **Applies standard Kalman Filter equations to *predict* track state and quality.**
    - **Deviates from the standard Kalman Filer to *update* those parameters.**

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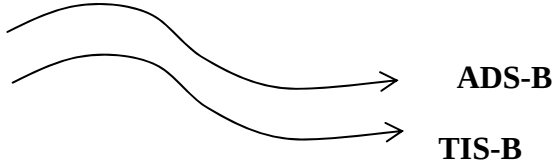
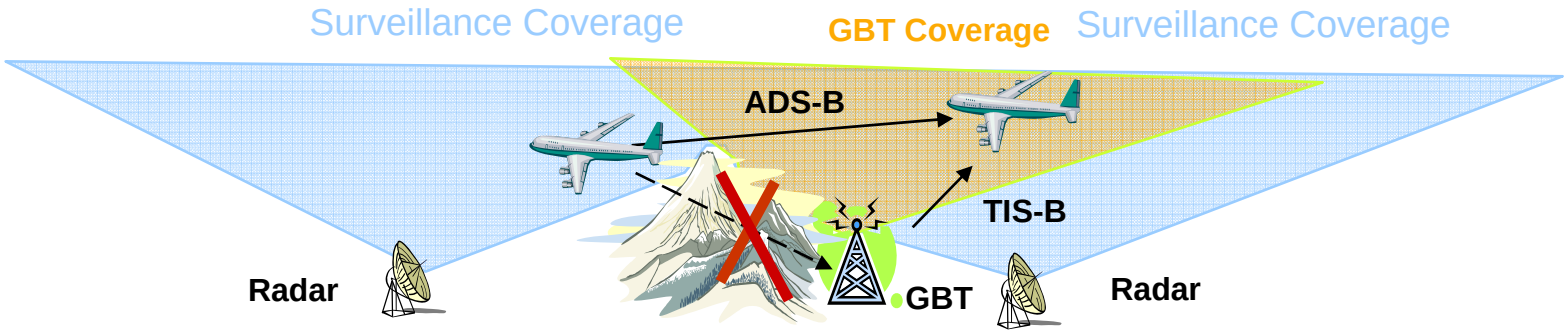
Highlights of Inter-Source Track Correlation

- **Correlation between ADS-B and TIS-B**
  - **Detects TIS-B shadows due to**
    - **TIS-B Ground Subsystem's failure to associate ADS-B tracks with tracks generated from other sources (e.g., radar).**



    - **ADS-B air-to-ground is limited due to line-of-sight blockage; air-to-air ADS-B is unhindered.**



Accomplishments/Status

- **ASSAP Surveillance Processing**
  - **Selection of Architecture, Development of Functional Requirements & Algorithms – *(Roxaneh) 90% complete***
  - **Implementation of Algorithms in MATLAB – *(Ganghuai) 80% complete***
- **Scenario Generator**
  - **Selection of Truth Trajectories – *(Roxaneh) complete***
  - **Quality Assurance of Truth Trajectories – *(Dwight) complete***
  - **Graphical Visualization of Trajectories – *(Roxaneh) complete***
  - **Specification of Functional Requirements of the Scenario Generator - *(Roxaneh) 80% complete***
  - **Algorithm Development and Implementation of Scenario Generator - *(Dwight) 30% complete***

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Future Work

- Short Term (6 months)
  - Complete Implementation of Scenario Generator and ASSAP Prototype
  - Develop Metrics for Performance Studies
  - Test Feasibility of Algorithms with Scenarios
    - Tune Thresholds Used in Association/Resolution/Correlation Algorithms
  - Integrate ASSAP Surveillance Processing with ASSAP Application Processing
  - Provide Graphical Visualization of ASSAP Traffic Information sent to CDTI
  - Brief RTCA WG and coordinate with CDTI subgroup
- Long Term (6 - 12 Months):
  - Conduct Performance Studies for Chosen Metrics
  - Write MOPS for ASSAP subsystem
  - Brief and coordinate with RTCA WG

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ASSAP Implementation

Ganghuai Wang

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ASSAP Surveillance Processing

- **Implement the ASSAP Surveillance Processing algorithm**
  - **Track association and resolution for each track type (e.g., ADS-B and TIS-B)**
  - **ADS-B to TIS-B (track to track) correlation/bonding**
  - **Best track selection**
  - **TCAS tagging**

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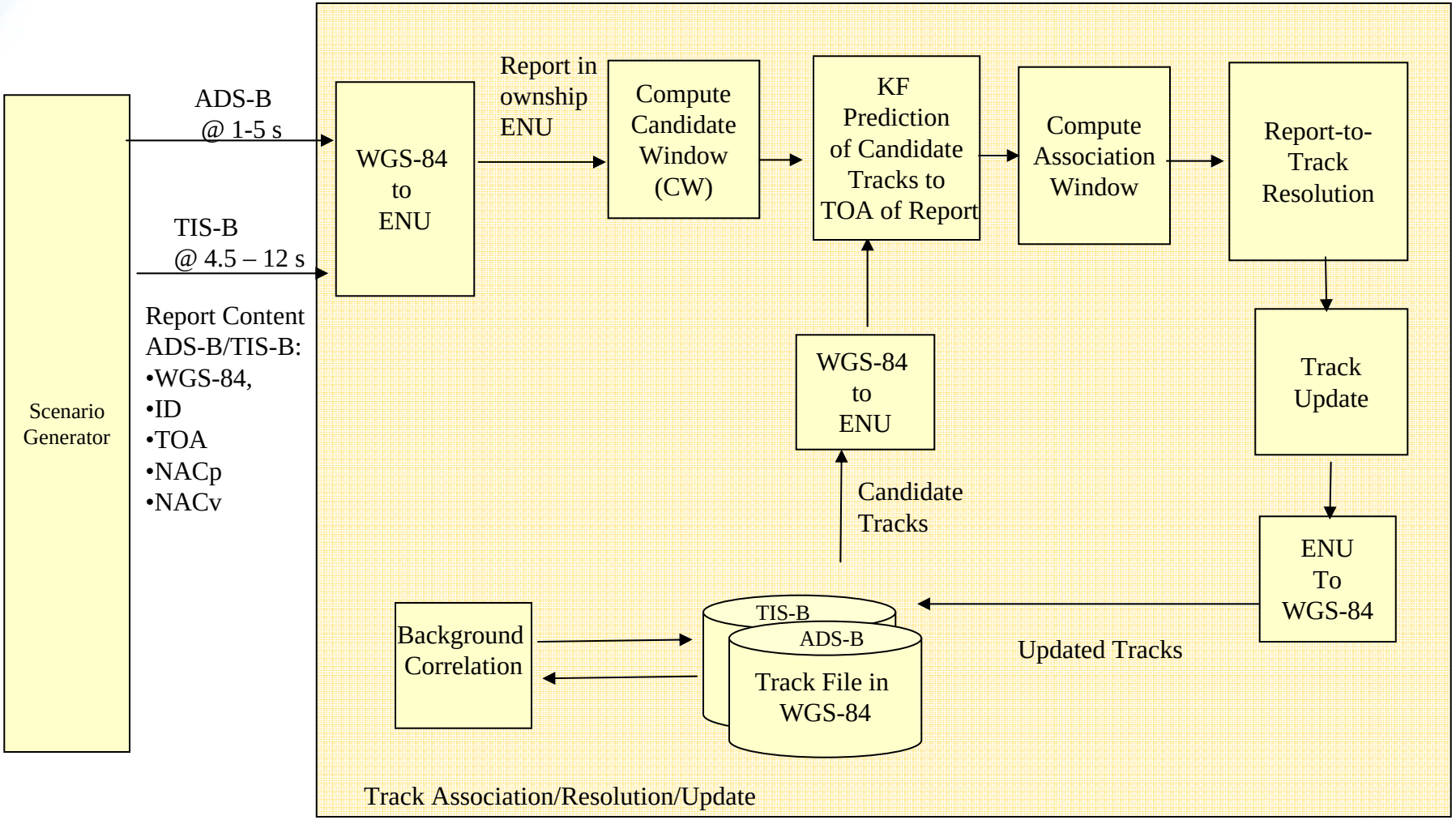
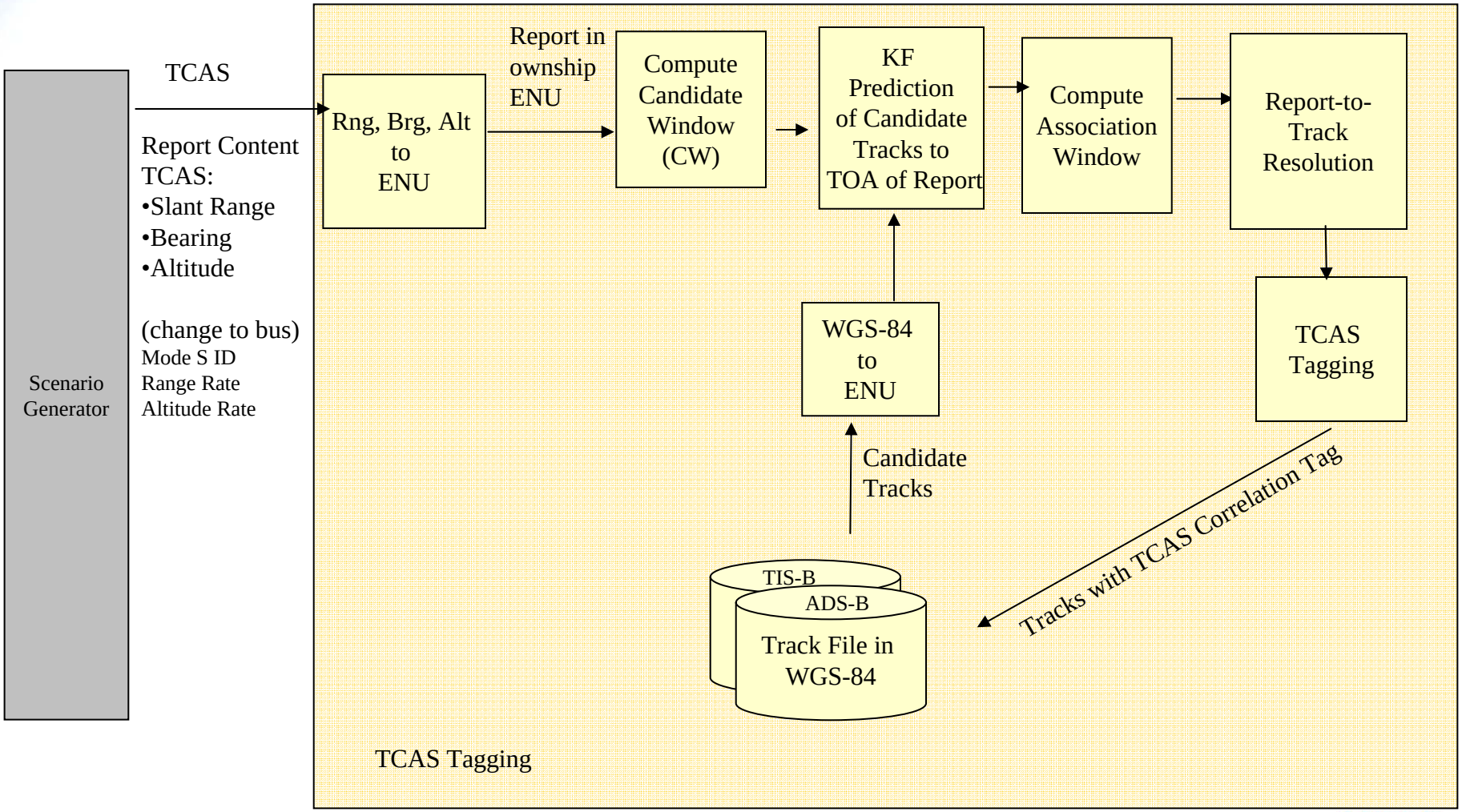
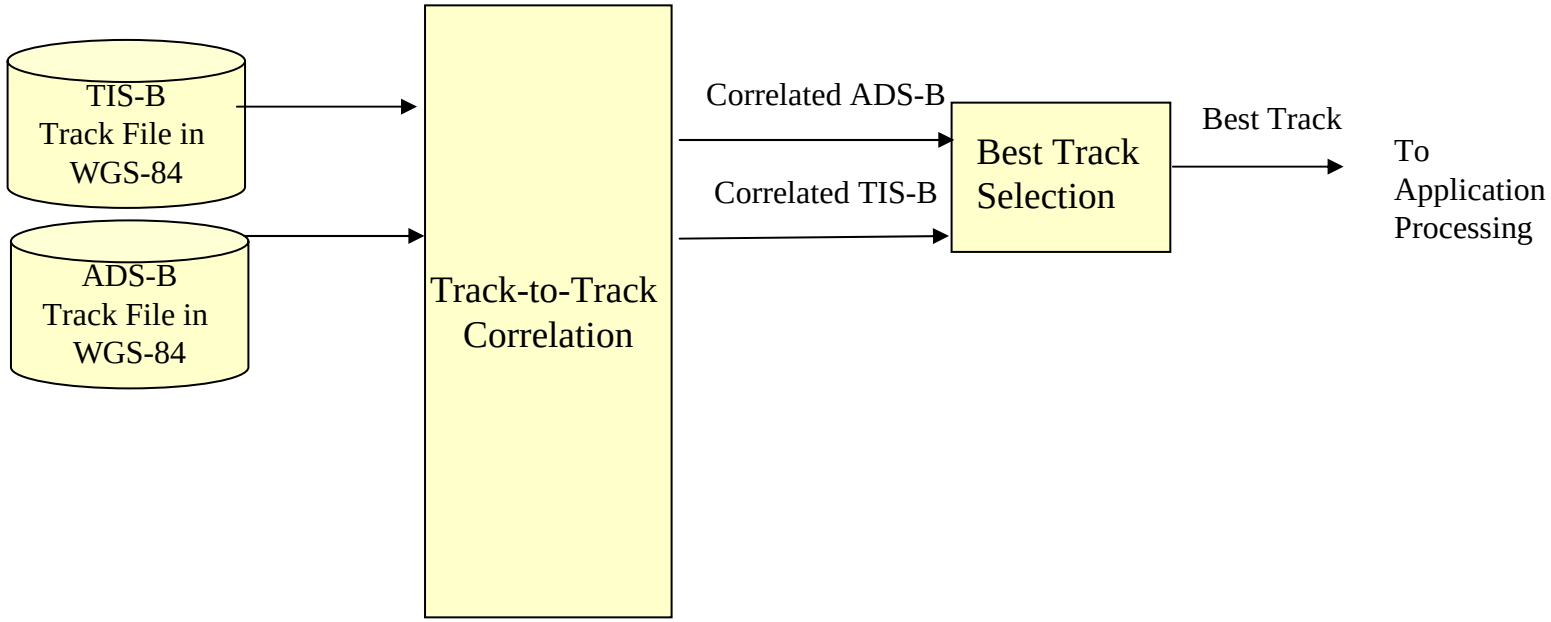
Process of Track Association/Update for each Track Type



Process of TCAS to ADS-B or TIS-B Correlation/Tagging



ADS-B to TIS-B Track-to-Track Correlation



ASSAP Application Processing

- **Selected best track from the ASSAP Surveillance Processing is provided to ASSAP Application Processing as input.**
- **The MITRE surveillance Monte Carlo simulation software is used for ASSAP Application Processing simulation study.**
- **The simulation software was used in deriving requirements for various ASSAP applications:**
  - **Conflict Detection**

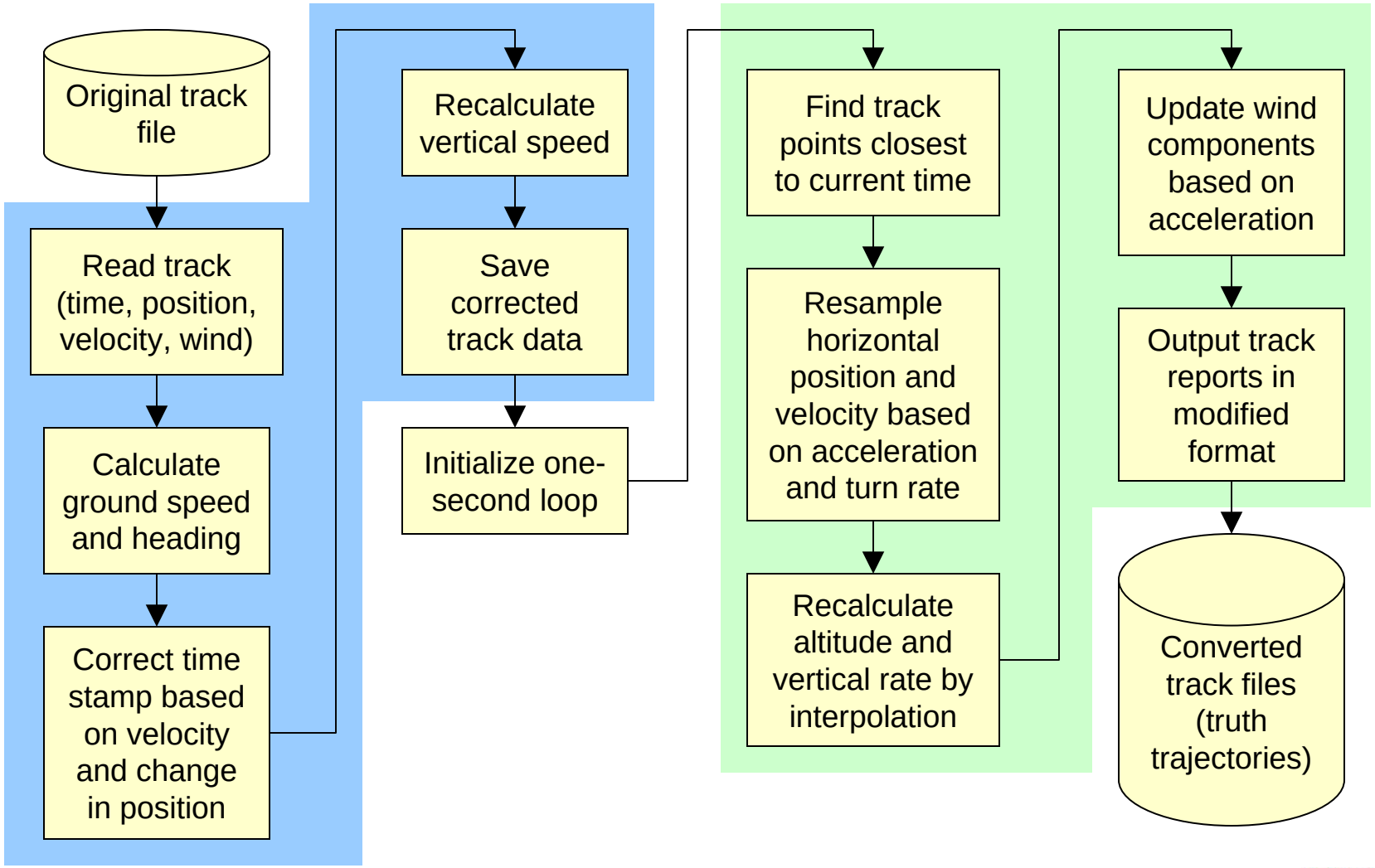
ASSAP Scenario Generator

Dwight Love

Scenario Generator — General Description

- **Goal: Generate realistic scenarios to test ASSAP design**
- **Methodology:**
  - **A. Convert existing scenarios**
    - **Start with realistic flight tracks for terminal scenarios originally created in the ATM Laboratory**
    - **Correct defects in the tracks and resample at a one-second update rate**
  - **B. Produce new scenarios**
    - **Using the converted tracks, assign source type (ADS-B, TIS-B, both) and ownship vs. intruders**
    - **Add noise to truth trajectories based on source type and phase of flight**
    - **Simulate TCAS measurements**
    - **Generate data files in format required by ASSAP simulation**

Scenario Converter — Block Diagram



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Scenario Generator — Block Diagram

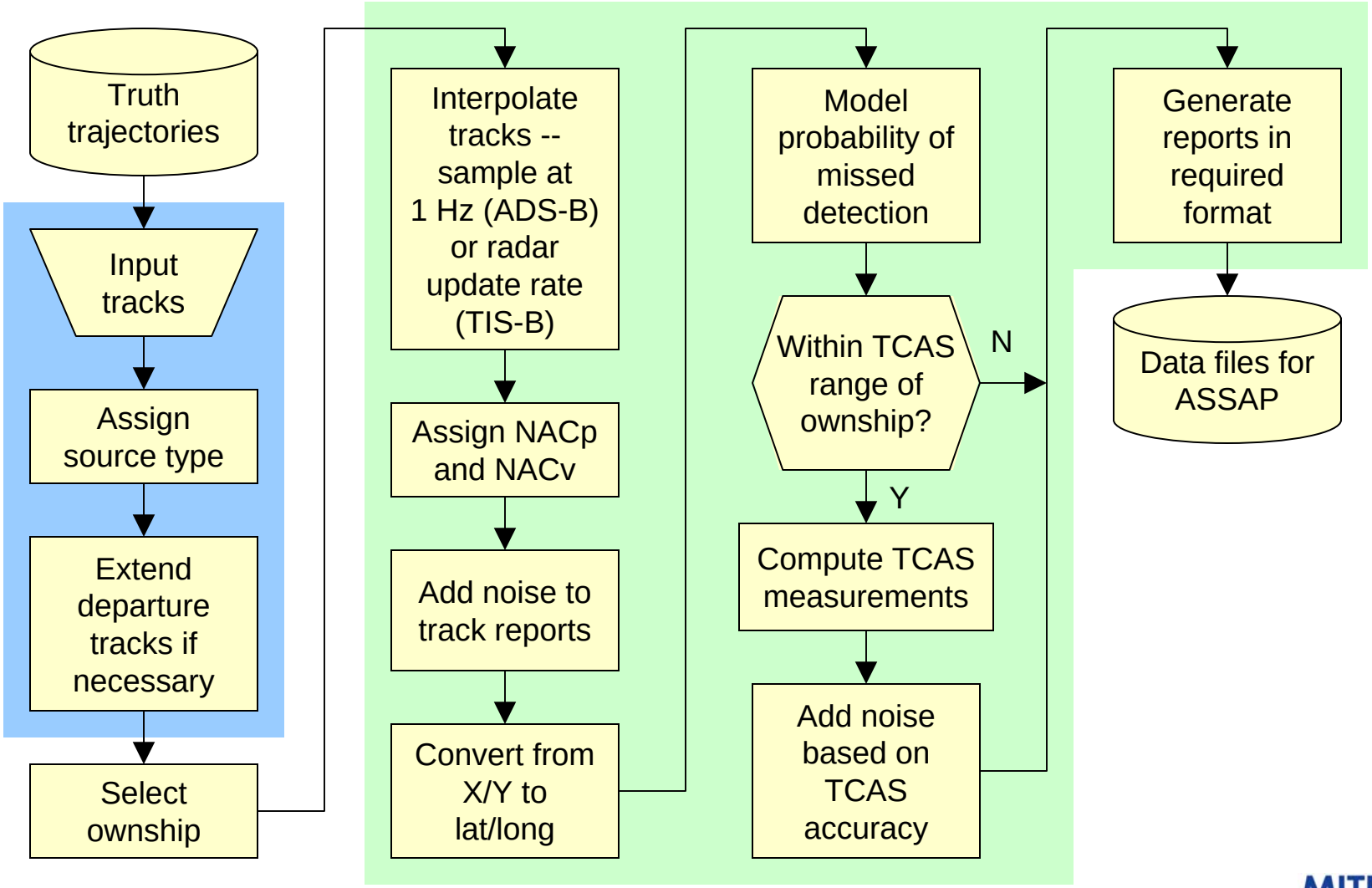
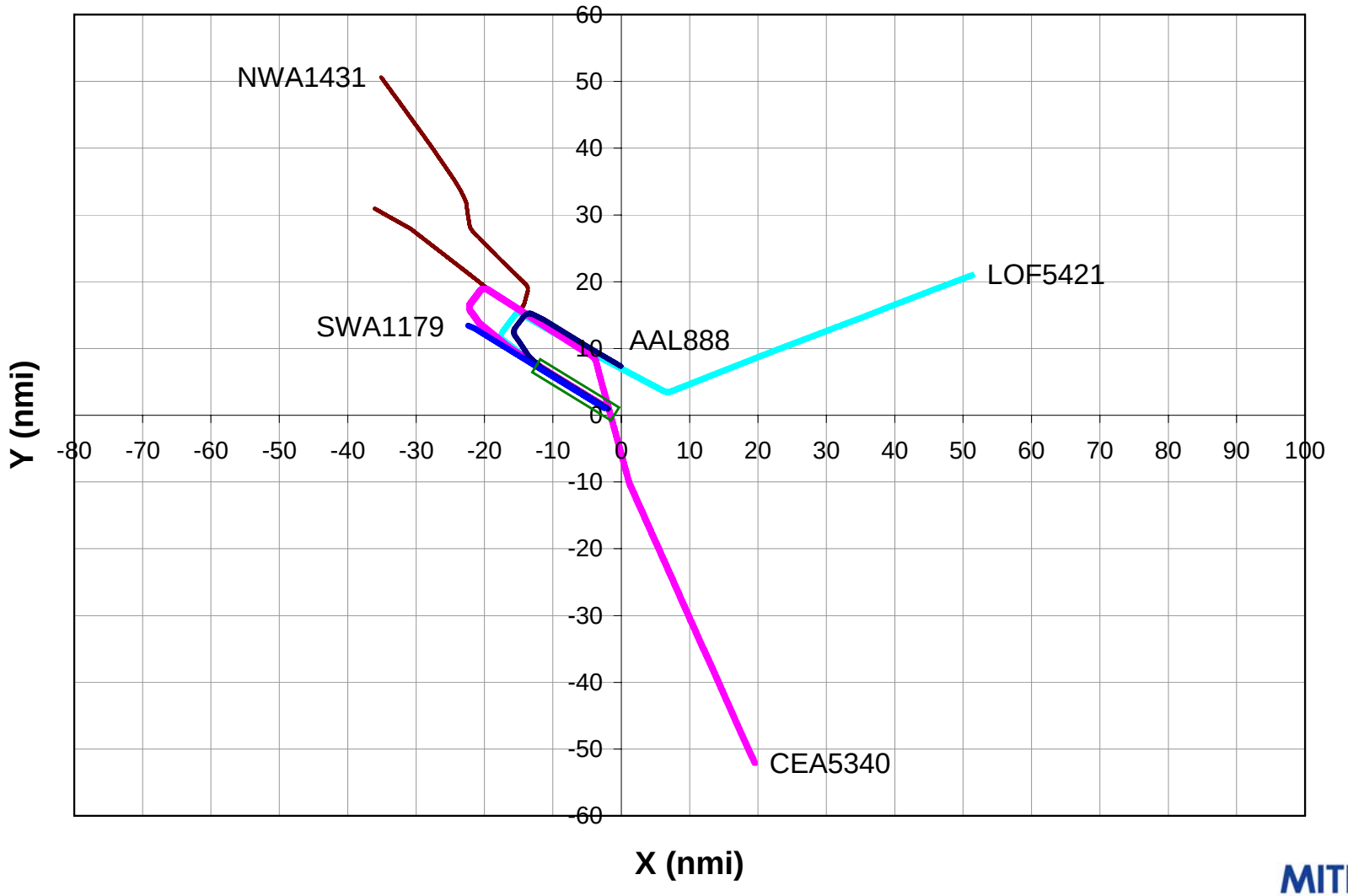


Illustration of Terminal Scenario



Graphical Visualization of Truth Scenarios

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